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Comparative Evaluation of Gross Erosion Assessment Techniques Used in the Blue Creek Watershed, Pike County, Illinois

Illinois State Environmental Protection Agency
Springfield

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Illinois Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Road
Springfield, Illinois 62706

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This study compares the results of a standard Soil Conservation Service Phase 1 Land Resource Inventory to those of a computerized geo-based (ADAPT) generated potential gross erosion estimate. The area studied was the Blue Creek Watershed, Pike County, Illinois. The goal was to determine whether the ADAPT system could delineate and quantify potential sediment source areas as accurately as the Phase 1 Inventory. The study concluded that ADAPT provided the means for delineating and quantifying potential sediment source areas as accurately as the traditional field method.

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written by

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January, 1982

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The assistance and contribution of Ming T. Lee, PhD, Professional Engineer of the Illinois State Water Survey was appreciated.

Portions of this report were taken from reports prepared for the Illinois Environmental Protection Agency concerning gross erosion assessment in the Blue Creek Watershed by Ming T. Lee (1981) and W.E. Gates and Associates, Inc. (1981 A & B).

John Little and Rodney Mutz of Illinois Environmental Protection Agency (IEPA) provided technical assistance throughout this project. The guidance, coordination and editorial comments of Robert Clarke, Martin Kelly, Dr. Hite, Kenneth Rogers and William Rice (IEPA) are greatly appreciated. This report was typed by the Word Processing II Unit under the direction of Norma Kraus.

Executive Summary

1. BACKGROUND: The Illinois Environmental Protection Agency (IEPA) in cooperation with the United States Department of Agriculture Agencies, Agricultural Stabilization and Conservation Service (ASCS) and Soil Conservation Service (SCS), is evaluating the impact of Resource Management Systems (RMS's) implemented under the ACP Special Water Quality Project in the Blue Creek Watershed; Pike County, Illinois. The primary objective of this project is to identify the most viable agricultural non-point source (NPS) control strategy, demonstrate its effectiveness, and develop a methodology to identify land causing water quality problems and to determine the appropriate RMS's.

2. INVESTIGATION: Adequate control of agricultural nonpoint source pollution requires an effective and efficient management program. A fundamental component of this program is the identification of specific areas that act as sources of nonpoint source pollution. The ability to identify and quantify source areas allows for targeting of resources and programs to correct the identified problems. Various predictive techniques have been developed that can be utilized to identify and quantify potential source areas. This study compares the results of traditional manual field inventory methods to those of a computerized geo-based generated potential gross erosion inventory system used at two different scales. The initial goal was to determine whether the ADAPT system could delineate and quantify potential sediment source areas as accurately as the manual field system.

3. SYSTEMS: The field inventory system utilized was the standard SCS Phase I Land Resource Inventory Method. The field data inventory was performed by SCS personnel. Data analysis was completed by ISWS. The ADAPT (Areal Design And Planning Tool) is a geo-based computer mapping and planning system. This system was used at the county level and field scale to determine potential gross erosion in the Blue Creek Watershed.

   The county level data base included: topography, detailed soils series and generalized land use information. For more detailed field level analyses, the data base was expanded to include more information on the existing land use/land cover characteristics. Land use/land cover was delineated by individual farm field boundaries for the field level analyses. For each field in a row crop rotation, the existing cropland management practices were defined. A list of the crop rotations, tillage systems, and conservation practices for the fields in the watershed is presented in the Appendix Section.

4. CONCLUSIONS: The study concluded that ADAPT provided a way for delineating and quantifying potential sediment source areas as accurately as the traditional field methods (Summary Table). In comparison, the ADAPT field level system and the field method produced equivalent results; there was no difference between woodland estimates, 1% for cropland, and 3% for the overall watershed erosion estimate. The ADAPT system required only 5% of the time input of local agency personnel as compared to the manual field method.

Summary Table: Potential Gross Erosion Rates in tons/acre/year (T/A/Y) by the land uses/cover categories designated by the ADAPT field level system for the Field Method study and the ADAPT field level study.

	Field Method				ADAPT -- Field Level		
Land Use/ Cover	# of Acres	Total Erosion	Erosion Rates	% different	# of Acres	Total Erosion	Erosion Rates
Cropland	1889	34141	18.1	+1	2004	36,687	18.3
Pasture	743	3064	4.1	-70	768.2	992	1.2
Woodland	186	910	4.9	0	287.8	1,396	4.9
Wildlife	238	693	2.9	-83	196.1	88	0.5
Other	188	2229	11.9	-	0	0	0
Feedlot	0	0	0	-	48	1651	34.4
Farmstead	23.1	49.1	2.1	-62	33.2	27.1	0.8
Total	3267.1	41,095	12.6	+3	3339.3	40,775	12.2

The comparative evaluation also indicated the following:

. All three methods can be utilized to establish priority project areas.

. All three methods can be utilized to select Resource Management Systems for each priority area.

. All three methods can be used to test new management strategies.

. All three methods can be used to evaluate the impact of state nonpoint pollution control strategies.

Introduction

The Federal Clean Water Act of 1977, Public Law 95-217, has mandated pollution abatement efforts directed toward controlling pollution at their sources rather than after the pollutant has entered the watercourse. The program (NPDES)[1] for control of point source discharges is well underway. The development of the "208" planning process has placed the emphasis on nonpoint pollutant control. Programs must be developed and implemented to minimize water quality degradation resulting from nonpoint pollutants.

Nationwide, agriculture is the most widespread cause of nonpoint source pollution. Initial "208" water quality planning efforts documented, that agricultural activities are a significant source of pollution in Illinois (Environmental Protection Agency, 1979). A severe agricultural related problem is soil erosion resulting in particulate matter transport. Nationally, approximately half of the total sediment delivered to streams and lakes is from cropland. The total volume of eroded material has been estimated to be 700 times more than point source contributions.

Sediment and suspended solids are classified as pollutants because of their physical properties and potential chemical interactions. Suspended sediment deteriorates water quality, physically and chemically, and results in reduced water uses.

To control agricultural nonpoint pollution from the source, effective and cost efficient land management practices and programs must be developed. A fundamental component of these programs is the identification of specific areas that significantly contribute to the problem. The ability to identify and quantify "source" areas allows for targeting of resources and programs to correct the problem areas.

Various predictive techniques have been developed that can be utilized to identify and quantify potential source areas. The most commonly used technique is the Universal Soil Loss Equation (Wischmeier and Smith, 1965). The Universal Soil Loss Equation (USLE) was designed to predict field losses in tons/acre on an average annual basis, it does not predict sediment delivery to streams. Both methods compared in this study utilized the USLE technique.

This study compares the results of the labor intensive SCS Phase 1 Land Resource Inventory to a computertized geo-based (ADAPT) generated potential gross erosion estimate. The ADAPT work was completed at two different scales. The spatial relationships and magnitude of the potential "source" areas were evaluated. This study used the Blue Creek Watershed in Pike County, Illinois as the base.

1. NPDES -- National Pollution Discharge Elimination System established by the Federal Water Pollution Control Act Amendments (FWPCA) of 1972, as amended PL 95-217.

THE BLUE CREEK WATERSHED PROJECT

The inventory of potential gross erosion is a component of the Blue Creek Watershed monitoring project administered by IEPA and funded in part by USEPA. This project's primary purpose is to determine the actual yield of pollutants from fields under a variety of agricultural practices to downstream receiving water and their effect upon the water quality and reasonable uses of the water resources. Monitoring and evaluation of actual Resource Management System (RMS) implementation progress on sub-watersheds and yield of pollutants to the major tributary streams and public water supply lake should provide a reliable comparison of low and high-cost practices and downstream yield reductions, evaluation of cause and effect relationships between a variety of practices, determination of NPS yields from lands requiring treatment to reduce water quality problems, and the impact of both on stream and lake quality. The objective of the inventory of the potential gross erosion component is to test methods for identifying "source" areas for use by Soil and Water Conservation Districts and to allow evaluation and modelling of water quality impacts of various soil conservation practices. IEPA's effort is in conjunction with an USDA-ACP Special Water Quality Project in the Blue Creek Watershed.

Study Area

The Blue Creek Watershed encompasses approximately 7,028 acres in east central Pike County, Illinois. Terrain is hilly, when compared with most areas in Illinois and has a high soil loss potential due to its steep slopes, fine-grained soils and agricultural land use practices (Table 1). The Blue Creek Watershed drains into Pittsfield City Lake, which was constructed in 1961. Average annual soil loss is estimated at 8.1 tons/acre/year (Illinois Environmental Protection Agency, 1979). Erosion from livestock operations (primarily hogs) significantly contribute to the total basin sediment load. This study took place on the upper half of the watershed above Highway 107 (Figure 1). For a more detailed description of the Blue Creek Watershed and the monitoring program refer to "Blue Creek Watershed Project Pike County, Illinois, May 1979 - October 1980" (Davenport, 1981).

Study area of the gross erosion assessment study in the Blue Creek Watershed, Pike County, Illinois

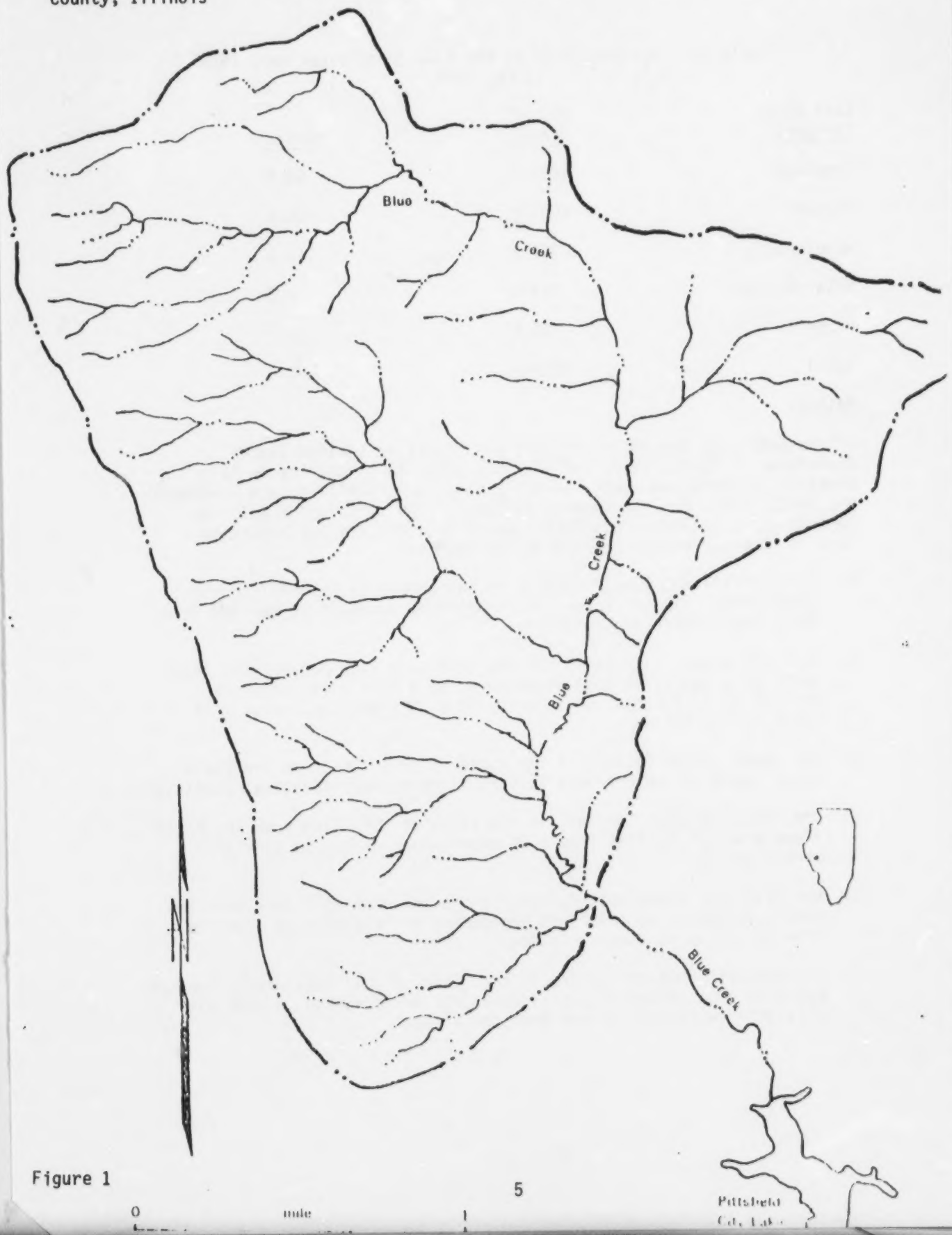


Figure 1

Table 1. Land Use/Cover in the Blue Creek Watershed, 1979 (IEPA, 1980)

Land Cover Category	No. of Acres	Percent
Cropland	4621.7	65.8
Pasture	1081.9	15.4
Woodland	964.3	13.7
Water/Wetland	299.5	4.3
Orchard	60.5	0.8
Total	7028.0	100

Methods

All systems used the Universal Soil Loss Equation (United States Department of Agriculture, 1977). This equation is applicable to cropland, pasture, woodland, wildlife land, and idle land (see Wischmeier and Smith, 1965, for development and use). The soil loss prediction formula is as follows: A = RKLSCP where A is the average annual soil loss in tons per acre predicted by the equation.

R: the rainfall and runoff factor, is the number of rainfall erosion index units, plus a factor for runoff from snowmelt or applied water where such runoff is significant.

K: the soil erodibility factor is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot, which is defined as a 72.6 ft. length of uniform 9% slope continuously in clean tilled fallow.

L: the slope-length factor, is the ratio of soil loss from the field slope length to that from a 72.6 ft. length under identical conditions

S: the slope-steepness factor, is the ratio of soil loss from the field slope gradient to that from a 9% slope under otherwise identical conditions.

C: the cover and management factor, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P: the support practice factor, is the ratio of soil loss with a support practice like contouring, stripcropping, or terracing to that with straight-row farming up and down the slope.

The USLE was designed to predict field losses in tons/acre or an average annual basis, it does not predict sediment delivery to streams.

Systems

A field method and a computerized method were used to determine potential gross erosion on the Blue Creek Watershed. The field method consisted of applying the USLE to the present land management activities employed on the Blue Creek Watershed. The computerized system (ADAPT) generated potential gross erosion for specified land management activities using the USLE. The computerized system was run at two levels of detail. The county level data base included: topography, detailed soils series and generalized land use information. For purposes of the more detailed field level analyses, it was necessary to expand the data base to include more information on the existing land use/land cover characteristics. Land use/land cover was delineated by individual farm field boundaries for the field level analyses. For each field in a row crop rotation, the existing cropland management practices were defined. Brief descriptions of the different systems are presented below for further information concerning the different systems obtain the cited reference or contact the appropriate author. An abstract of each study is in the Appendix Section.

Field Method (Lee, 1981)

The Illinois State Water Survey (ISWS) in cooperation with the Soil Conservation Service (SCS) and contracted by the Illinois Environmental Protection Agency (IEPA) evaluated the potential gross erosion conditions in the watershed. The erosion assessment was divided into two components; field data inventory and data analysis. Wayne Kinney, District Conservationist, Steve Chick and Edward Johnston, Soil Conservationist of the SCS performed the field data inventory. Ray Herman, Resource Conservationist with the SCS, helped provide ISWS the detailed soil mapping unit descriptions. Ming T Lee, P.E., and William Fitzpatrick of the ISWS performed data analysis.

The field data inventory utilized the standard SCS Phase 1 Land Resource Inventory method. The study area was divided into 36-160 acre sampling units. Within each sampling area, homogenous land use is defined as a field area; within this field area, appropriate soil mapping units were delineated on the map and recorded on the worksheet. Twenty-eight (28) items are recorded on the worksheet for each recording unit. The information required for each recording unit is listed in the Appendix Section. For a detailed description of the Standard SCS Land Resource Inventory Method, refer to "Illinois Environment Assessment Procedure," (USDA-SCS, 1977A).

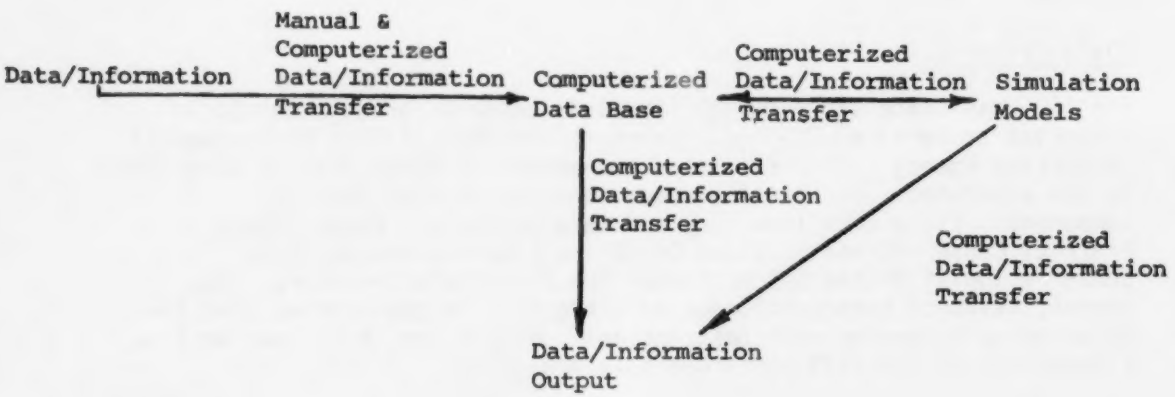
Data analysis was completed by ISWS. The data collected through the field inventory process was inputted into the USLE, for the computation of soil loss rates.

"The soil loss rates were computed based on each soil mapping unit. The acreage of the same soil mapping unit were aggregated. The total amount of gross erosion is the sum of all the gross erosion from each soil mapping unit in all field sites. The average erosion rate is defined as the amount of gross erosion divided by the acreage. The standard deviation of the erosion rates in all the field sites was computed. The maximum and minimum erosion rates were recorded. The total number of the sample was also recorded." (Lee, 1981) The potential gross erosion for various alternative erosion control practices was also determined during this study.

Computerized Method (W. E. Gates, 1981)

ADAPT (areal design and planning tool) a geo-based computer mapping and planning system was utilized for determining potential gross erosion on the Blue Creek Watershed. This computer modeling system represents a synthesis of two popular computer based approaches to analysis and planning, 1) spatial/geographical data base; and 2) analytical mathematical modeling techniques.

"The basic modules of ADAPT are:



The data/information incorporated into the data base is determined by the needs of the particular ADAPT application. A combination of manual and computer based techniques are used to capture the data/information and transfer it to the computerized data base.

USGS, 7 1/2 minute maps provided the topographical and political boundaries; soil series data was provided by SCS. Land cover/land use in five categories for the county level study and in fourteen categories for the field level study was furnished by IEPA and SCS from aerial photos

and ground surveys (Table 2). USLE factors: cropping (C) and conservation practice (P) were representative numbers provided by the local District Conservationist of the SCS. This information is listed in the Appendix Section. The length factor, also obtained from SCS, was a representative slope length for each soil series. The slope factor was calculated by the ADAPT system. The soil erodibility factor and the rainfall factor were obtained from Resource Conservation Planning Technical Note - IL-4 (USDA-SCS, 1977B).

The county level data base included: topography, detailed soils series and generalized land use information. When completed the data base cell size ranged from an order of less than 1 to 60 acres. For purposes of the more detailed field level analyses, it was necessary to expand the data base to include more information on the existing land use/land cover characteristics. Land use/land cover was delineated by individual farm field boundaries for the field level analyses. For each field in row crop rotation, the existing cropland management practices were defined. A list of the crop rotations, tillage systems, and conservation practices making up these management practices for the fields in the watershed is presented in the Appendix Section. The range of cell size was from .06 to 8.19 acres (average = .88 acre) for the completed field level data base.

The county level study's baseline scenario assumed that all cropland in the watershed was under conventional tillage, residue left; fall up and down plowing. For the field level study present land management activities were delineated by the local District Conservationist, Wayne Kinney and Environmental Protection Specialist Rod Mutz (IEPA). The county level and the field level studies also consisted of determining the potential gross erosion under specified management alternatives for the watershed. Each alternative had the effect of changing the land cover/use, cropping practice or slope factors for the USLE computations. Calculation of potential gross erosion under these various alternatives gives a general idea of the relative effectiveness of these practices in this watershed. The local Soil Conservationist, Ed Johnston provided the necessary C and P factor information for the field level study.

Table 2. Land use/cover classification used by W.E. Gates and Associates in the Land/Cover Water Quality Relationships (County level) project and the field level study on the Blue Creek Watershed

Land Use/Cover	County Level	Field Level
Cropland	X	
C-Sb		X
C-C-Sb		X
Continuous C		X
C-Sb-Gr		X
C-Sb-Gr-M		X
C-Sb-Gr-M-M-M		X
Pasture	X	
Pasture/Hay 80% Cover		X
Pasture/Hay 95% Cover		X
Woodland	X	
Woodland Managed		X
Woodland Unmanaged		X
Wildlife		X
Farmstead		X
Feedlot		X
Orchard	X	
Water/Wetland	X	X

C; Corn
Sb; Soybeans
Gr; Grain
M; Meadow

Results

Results from the application of the field and computer generated potential gross erosion methods are summarized in tables 3, 4 and 5, respectively. Figures 2, 3, and 4 spatially locate the potential gross erosion by soil loss category.

Field (Lee, 1981)

Potential gross erosion and erosion rates by land use for the study area (Figure 1) are summarized in Table 3. The mean erosion rate for the 3268 acre study area was 12.6 tons/acre/year.

The mean annual erosion rates ranged from 18.1 tons/acre for cropland to 0.2 tons/acre for residential. Present land management activites determined the cropping and conservation practice factors of the USLE. Only two land use categories had an annual mean erosion rate of over 10 tons/acre these were cropland (18.1) and "other" (11.9). Other is

defined as "ideal, natural areas and small tract areas that were not defined in the inventory" (Lee, 1981). Pasture, woodland, wildlife habitat, farmstead, hayland, recreation and residential soil loss rates range from 5.5 to 0.2 tons/acre/year.

Figure 2 depicts the location and severity of potential soil erosion in the study area. Variations in potential soil loss on cropland, are the result of a combination of different management activites and geomorphic characteristics inherent to the individual land management units.

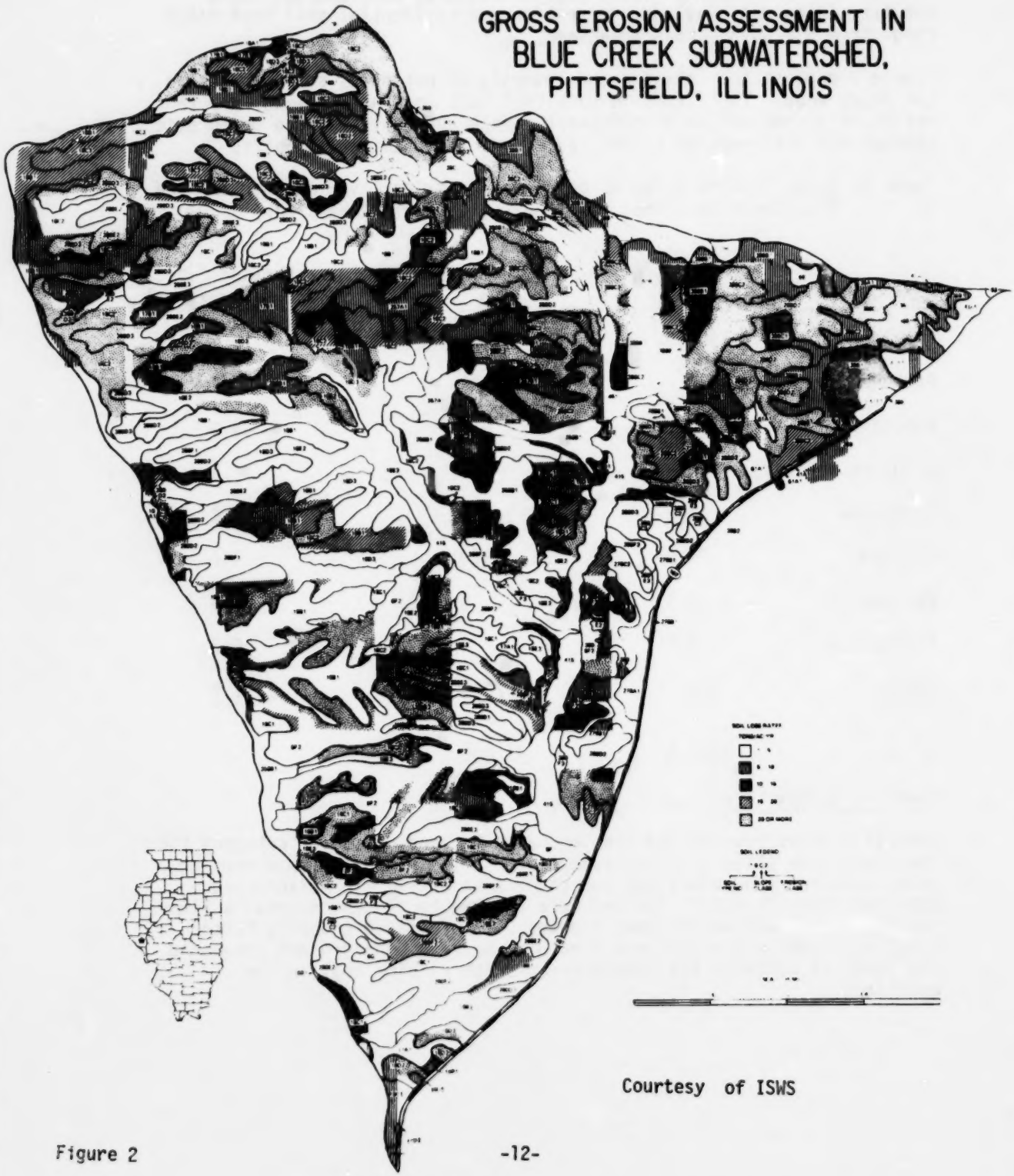
Table 3. Gross Erosion Rates of Different Land Use/Cover Categories, The Blue Creek Watershed Pike County, Illinois (Lee, 1981)

Land Use	Acreage	Total Erosion Tons	Erosion Rate (Tons/Acre/Year)
Cropland	1889	34,141	18.1
Pasture	670	2941	4.4
Woodland	186	910	4.9
Wildlife habitat	238	693	2.9
Farmstead	18	40	2.2
Hayland	73	128	1.8
Recreation	1.5	8.5	5.5
Residential	4.1	0.6	0.2
Others	188	2229	11.9
Total	3267.6	41,095	

ADAPT -- County Level (Gates, 1981A)

Potential gross erosion and erosion rates by land use/cover category for the study area (Figure 1) are summarized in Table 4. The mean erosion under baseline conditions for the study area was 28.4 tons/acre/year. Baseline conditions for cropland were assumed to be conventional tillage, residue left, fall up and down plowing. The woodland cropping factor (.08) utilized in the USLE was a weighed mean for managed and unmanaged woodland, it reflects the common practice of raising hogs in the woodlands.

The location and severity of potential soil erosion in the study area determined using the Field Method



Courtesy of ISWS

Figure 2

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The average annual erosion rates ranged from 37.2 tons/acre for cropland to 1.8 tons/acre for pasture. The woodland land use category had an annual average erosion rate of 14.5 tons/acre. Figure 3 depicts the location and severity of potential soil erosion in the study areas as determined using ADAPT at the county level.

Table 4. Potential Gross Erosion Rates by land use/cover category in the study area of the Blue Creek Watershed at the County Level. (W.E. Gates, 1981A)

Land Use/ Cover	Number of Acres	Total Erosion (Tons)	Erosion Rate (Tons/Acre/Year)
Cropland	2402.9	89,484.4	37.2
Pasture	617.2	1125.5	1.8
Woodland	325.6	4733.9	14.5
Orchard	0	0	0
Water/Wetland	14.2	0	0
	3359.9	95344.8	28.4

ADAPT -- Field Level (Gates 1981B)

Potential gross erosion and erosion rates by land use/cover category for the study areas as determined using ADAPT on the field level are summarized in Table 5. The mean erosion given the presently defined conditions for the study area was 12.2 tons/acre/year.

Mean erosion rates ranged from 18.3 tons/acre for cropland to 0.5 tons/acre for wildlife areas. Only cropland and feedlot areas had an annual mean erosion over 10 tons/acre, these were 18.3 and 34.4 tons respectively. The remaining land use/cover categories had annual average soil losses under 10 tons/acre.

Within the cropland land use/cover category annual erosion rates ranged from 28.4 tons/acre for a corn, soybean rotation to 7.3 tons/acre for a corn, soybean, grain, meadow, meadow, meadow, meadow rotation. Mean woodland erosion rates ranged from 8.6 tons/acre for unmanaged areas to 0.6 tons/acre for managed. Both pastures/hayland categories had mean annual erosion rates of under 2 tons/acre. Variations in potential soil loss on cropland, pasture/hayland and woodland results from a combination of different management activities and geomorphic characteristics of the individual land management units.

The location and severity of potential soil erosion in the study area determined using the ADAPT system at the county level

Figure 3

Figure 4 depicts the location and severity of potential soil erosion in the study area as determined using ADAPT at the field level.

Table 5. Potential Gross Erosion Rates by Land Use/Cover Category in the Study Area of the Blue Creek Watershed at the Field Level (W.E. Gates, 1981B)

Land Use/ Cover	Number of Acres	Total Erosion (Tons)	Erosion Rate (Tons/Acre/Year)
C-Sb	512.9	14575	28.4
C-C-Sb	184.6	4493	24.3
Continuous C	637.7	11560	18.1
C-5b-Gr	37.3	701	18.8
C-Sb-Gr-M	343.8	3179	9.2
C-Sb-Gr-M-M-M	142.6	1098	7.7
C-Sb-Gr-M-M-M-M	147.1	1081	7.3
Pasture/Hay 80% Cover	442.6	812	1.8
Pasture/Hay 85% Cover	325.6	110	0.3
Woodland Managed	134.2	77	0.6
Woodland Unmanaged	153.6	1319	8.6
Wildlife	196.1	88	0.5
Farmstead	33.2	27.1	0.8
Feedlot	48.0	1651	34.4
	3,339.3	40,775	12.2

C; Corn
Sb; Soybeans
Gr; Grain
M; Meadow

The location and severity of potential soil erosion for the study area determined using the ADAPT system at the field level

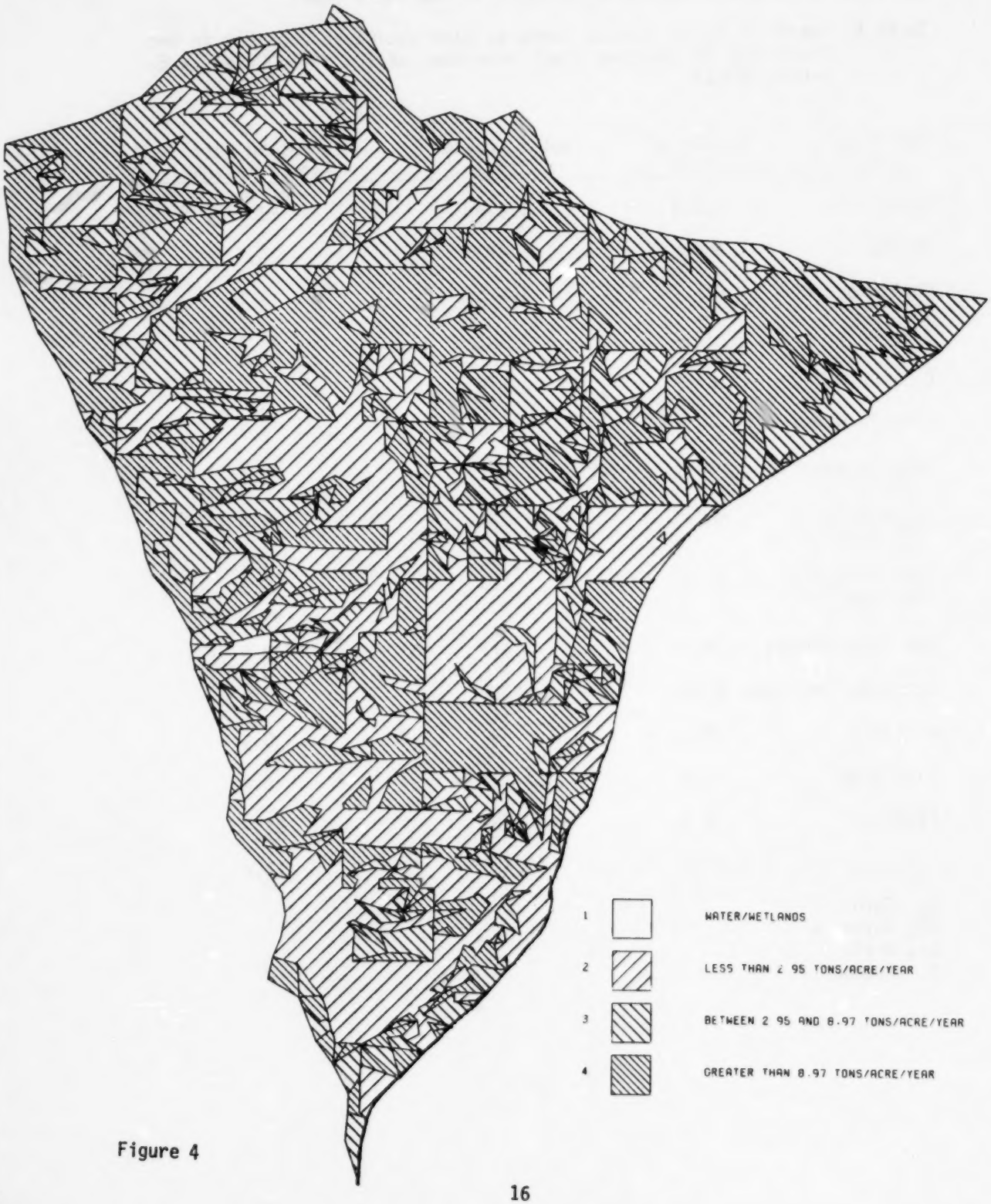

Figure 4

Field Check of ADAPT Field Level Study

The computerized field level study was field verified on a representative field in the northwestern section of the watershed owned by Dwight Dunham. Edward Johnston, Soil Conservationist SCS, made the necessary measurements and U.S.L.E. calculation.

Field calculations estimated erosion to be 24 tons/acre/year. The ADAPT field level study estimated erosion to be 22.28 tons/acre/year. The 7% difference probably results from increased accuracy of the field length-slope (LS) measurement. "The LS factor is particularly sensitive to errors in measuring average slope because these errors are magnified in calculating LS for slopes above about 3 percent. Errors in measuring the average slope length are not as critical because they are reduced by half or more in calculating LS (Williams and Berndt, 1977)." The ADAPT system calculates the percent slope and uses an average slope-length factor for each soil series, whereas the manual method incorporates actual field measurements.

Discussion

The goal in using the ADAPT system was to evaluate the computerized method in a management context. In this case, would the computerized method delineate and quantify potential sediment "source" areas as accurately as the field method? All three studies utilized the U.S.L.E. technique for quantifying potential sediment "source" areas.

Both methods utilized, are expensive in terms of either manpower and/or fiscal resources. Implementation of the ADAPT method at the field level required less time input of local agency personnel than the field method. In terms of professional/technical man-days, it was estimated the field method's data inventory required 28 man-days and the ADAPT field level method 1.5. The ADAPT method's man-day estimate does not include the time the local SCS personnel expended during the project furnishing the necessary "C" and "P" factors or in clarification of the data inputs. No manpower estimates were made of time expended by ISWS personnel completing the data analysis component of the field method or by the contractor completing the ADAPT field level study. The time input factor is an important characteristic because the local SCS personnel are the key to getting good conservation practices implemented by the farmer owners/operators within the designated priority areas. Utilization of the ADAPT method gives local SCS personnel more time for personal contact with farm owners/operators. ADAPT also provides a means for graphically showing the individual owner/operator the impacts that various resource management systems would have on their on-site erosion problems.

Gross Erosion Estimates

Gross erosion estimates for each method are shown in Table 6. The considerable deviation between the computerized county level and field

level estimates is a result of delineation levels for cropping practices and detail of the data and terrain. For the field level study, cropping practices were the present land management activities that were specified by the local District Conservationist, for the county level study, a worst case condition that assumed all cropland was under corn-soybean rotation, conventional tillage, residue left, fall up and down plowing management was utilized. Table 2 lists the land/use cover categories used for the ADAPT system. Seven different crop rotations were specified in the field level study versus one for the county level. The field level study estimated potential gross erosion for corn, soybean rotation under the present land management to be 28.4 ton/acre/year as compared to the 37.2 tons/acre/year estimated for cropland during the county level study.

The deviation in number of acres by land use/cover categories between the ADAPT county and field level studies also results from the level of delineation of land use/cover at the field level. The differences in the number of acres by land use/cover category between the ADAPT field level and the field method results from the variation in land/use cover categories utilized in each study and the methods of delineation. An example of variation in category is pasture/hayland designation, for the field level study this was grouped as one category whereas for the field method hayland and pasture are separate categories. Land/use cover was delineated in the field for the field method whereas for the ADAPT - field level study land use/cover was determined using aerial photography and a office generated watershed base map which had discrete field boundaries.

Table 6. Potential gross erosion rates in tons/acre/year (T/A/Y) by land use/cover category and type of system used to determine rates

	"Worst Case" ADAPT County Level (Gates 1981A)			Present Condition Manual Method (Lee, 1981)			Present Conditions ADAPT Field Level (Gates, 1981B)		
Land Use/Cover	# of Acres	Total Erosion (Tons)	Erosion Rates (T/A/Y)	# of Acres	Total Erosion Tons	Erosion Rate (T/A/Y)	# of Acres	Total Erosion (Tons)	Erosion Rate (T/A/Y)
Cropland[1]	2403	89,484	37.2	1889	34,141	18.1	2006	36,687	18.3
Pasture[2]	617	1,125	1.8	670	2,941	4.4	786.2	992	1.2
Woodland[3]	326	4,734	14.5	186	910	4.9	287.8	1,396	4.9
Wildlife	14	0	0	238	693	2.9	196.1	88	0.5
Farmstead[4]	0	0	0	18	40	2.2	33.2	27.1	0.8
Hayland[2]	0	0	0	73	128	1.8	See 2		
Recreation	0	0	0	1.5	8.5	5.5	0	0	0
Residential[4]	0	0	0	4.1	0.6	0.2	0	0	0
Other	0	0	0	188	2,229	11.4	0	0	0
Feedlot	0	0	0	0	0	0	48	1,651	34.4
Total	3,360	95,343	28.4	3,267	41,095	12.6	3,339.3	40,775	12.2

1. Computerized field level all cropland management activities combined and averaged into cropland category.
2. Computerized field level all pasture/hayland activites combined and averaged into pasture category.
3. Computerized field level unmanaged and managed woodland activities combined and averaged into woodland category.
4. Computerized field level did not differentiate residential from farmstead.

Table 7. Potential Gross Erosion rates in tons/acre/year (T/A/Y) by the land uses/cover categories designated by the ADAPT field level system for the field method study and the ADAPT field level study.

	Field Method			ADAPT -- Field Level		
Land Use/ Cover	# of Acres	Total Erosion	Erosion Rates	# of Acres	Total Erosion	Erosion Rates
Cropland	1889	34141	18.1	2004	36,687	18.3
Pasture	743	3064	4.1	768.2	992	1.2
Woodland	186	910	4.9	287.8	1,396	4.9
Wildlife	238	693	2.9	196.1	88	0.5
Other	188	2229	11.9	0	0	0
Feedlot	0	0	0	48	1651	34.4
Farmstead	23.1	49.1	2.1	33.2	27.1	0.8
TOTAL	3267.1	41,095	12.6	3339.3	40775	12.2

In comparison, the ADAPT field level method and the field method estimates of average potential gross erosion were equivalent. Tables 6 and 7 shows that there was no difference between woodland estimates, 1% for cropland, and 3% for the overall watershed erosion estimate. There are significant differences in the pasture, wildlife, and farmstead categories. ADAPT field level's pasture estimate of mean potential gross erosion are only 1/3 of the field method's estimate. The field level study combined hayland with pasture, included grassed waterways as pasture and only allowed two levels of groundcover (80 & 95%) whereas the field method allowed the actual field conditions to be taken into consideration. The wildlife category's difference resulted from the assumption made that all wildlife areas had a "C" factor of .003 for the ADAPT field level study when for the field method it could range from .003 to .42. Differences between residential, farmstead and recreational categories for the ADAPT field level and field method studies result from the land use/cover delineations and assumptions made for each category.

Extrapolation of Results

Ming Lee, ISWS; used the results of the field method study to estimate gross erosion for the entire watershed. He assumed that the remainder of the watershed had a similar erosion rate. The total amount of annual gross erosion was computed to be 86,676 tons. The ADAPT - field method

was applied to the entire watershed as part of the study. The annual gross erosion was computed to be 62,867 tons or 72% of the field method's extrapolation. This is attributed to the fact that the land cover/use composition in the study area is different from the remainder of the watershed (Table 8). The management pattern in the remainder of the watershed is distinctly more conservation oriented than that of the study area.

Lee (1981), also correlated the lake sedimentation data from Pittsfield Lake with the estimated gross erosion rate, computed using the field method, to determine the sediment delivery ratio. His analysis indicated that the delivery ratio is 48 percent. Utilizing the ADAPT field level gross erosion estimate and correlating it with the lake sedimentation data a different sediment delivery ratio is calculated. The sediment delivery ratio is 66 percent, a 38 percent increase over the ratio calculated by Lee.

Utilization of the ADAPT method, creates a geo-based data base for future use. It allows for greater user flexibility than the field method due to user capability for updating data files. Once the field method has been completed that is all you have, whereas with the ADAPT method you have the potential for future data manipulation.

Table 8. Land use/cover categories in the Blue Creek Watershed, study area, and the remainder of the watershed by acres and percent

Land Use/ Cover	Blue Creek Watershed # of Acres	%	Study Area # of Acres	%	Remainder # of Acres	%
C-Sb	760.2	(10.8)	512.9	(15.4)	247.3	(6.7)
C-C-Sb	315.5	(4.5)	184.6	(5.5)	130.9	(3.6)
Continuous C	931.7	(13.3)	637.7	(19.1)	294.0	(8.0)
C-Sb-Gr	129.5	(1.8)	37.3	(1.1)	92.2	(2.5)
C-Sb-GR-M	466.1	(6.6)	343.8	(10.3)	122.3	(3.3)
C-Sb-Gr-M-M-M	601.3	(8.6)	142.6	(4.3)	458.7	(12.5)
C-Sb-Gr-M-M-M-M	756.5	(10.8)	147.1	(4.4)	609.4	(16.6)
Past/Hayland - 80%	731.3	(10.4)	442.6	(13.3)	288.7	(7.9)
Past/Hayland - 95%	788.0	(11.2)	325.6	(9.8)	462.4	(12.6)
Woodland Managed	543.6	(7.8)	134.2	(4.0)	409.4	(11.1)
Woodland Unmanaged	266.4	(3.8)	153.6	(4.6)	112.8	(3.1)
Wildlife	311.7	(4.4)	196.1	(5.9)	115.6	(3.1)
Farmstead	109.1	(1.6)	33.2	(0.9)	75.9	(2.1)
Feedlot	65.5	(0.9)	48.0	(1.4)	17.5	(0.5)
Water	236.4	(3.5)	0		236.4	(6.4)
Total	7012.8	100	3339.3	100	3673.5	100

Delineation of Potential Sediment Source Areas

Figures 2, 3, and 4 depict the location and severity of potential soil erosion in the study area as determined by the various methods. There is considerable variation in severity between Figures 2-3 and 4-3. Figure 3 depicts the potential soil erosion for the county level where a uniform cropping system was compared to the more detailed manual and ADAPT field-level studies. All three methods spatially delineated similar areas of high potential gross erosion. In general, the identified priority "source" area of any of the three methods would be the same.

Effectiveness of Resource Management Systems

In order to simulate changes of soil loss rates due to select Resource Management Systems in the project area, various management scenarios were applied. Calculation of total soil loss under these various circumstances gives a general idea of the relative effectiveness in this watershed of the different practices. These practices were only applied to the cropland area, regardless of the appropriateness of the practices. In general, the practices identified as effective in controlling potential erosion from the "source" areas in this watershed by any of the three methods were the same.

Conclusions

1) The ADAPT computerized method utilizing a field level data base delineated and quantified potential sediment source areas as accurately (3%) as the field method (Phase 1 Land Resource Inventory System) currently used by the USDA-Soil Conservation Service in Illinois.

2) All three methods (two field) can be utilized to establish priority source project areas.

3) All three methods can be used to help select Resource Management Systems for each area.

4) ADAPT system using either a field level data base or county level data base required less time input by the field personnel.

5) All three methods can be used to test new management strategies for large areas.

6) All three methods can be used to evaluate the impact of State nonpoint pollution control strategies.

Literature Cited

Davenport, T.E. 1981. Blue Creek Watershed Project, Pike County, Illinois, May 1979 - October, 1980. Planning Section; Division of Water Pollution Control; Illinois Environmental Protection Agency; Springfield, Illinois. 64 pp.

Gates, W.E. and Associates, Inc. 1981A. Data/Information Development For Assessing Impacts of Cropland Management Practices on Potential Annual Erosion, Final Report to Illinois Environmental Protection Agency; Batavia, Ohio. 26 pp.

Gates, W.E. and Associates, Inc. 1981B. Data/Information Development For Assessing Impacts of Cropland Management Practices on Potential Annual Erosion and Economic Factors For Individual Fields in the Blue Creek Watershed, Final Report to Illinois Environmental Protection Agency; Batavia, Ohio. 26 pp.

Illinois Environmental Protection Agency. 1979. State of Illinois Water Quality Management Plan, Volume III. Planning and Standards Section; Division of Water Pollution Control, IEPA. Springfield, Illinois. 384 pp.

Illinois Environmental Protection Agency. 1980. Limnology of Pittsfield City Lake. Monitoring Unit; Division of Water Pollution Control; IEPA. Springfield, Illinois. 87 pp.

Lee, M.T. 1981. Gross Erosion Assessment in the Blue Creek Watershed, Pike County, Illinois. Illinois State Water Survey, Urbana, Illinois. 29 pp.

United State Department of Agriculture - Soil Conservation Service, State of Illinois. 1977. Illinois Environmental Assessment Procedure (worksheets revised 1979); Champaign, Illinois. 92 pp.

United States Department of Agriculture - Soil Conservation Service, State of Illinois. 1977. Resource Conservation Planning Technical Note-IL-4 (Rev. 1), Subject - Universal Soil Loss Equation. 44 pp.

Weschmeier, W.H., and D.D. Smith. 1965. Predicting rainfall-erosion losses from cropland east of the Rocky Mountains, USDA Agric. Handbook 282. Agricultural Research Service - U.S. Dept. of Agriculture and Purdue Agricultural Experiment Station, Washington, D.C. 47 pp.

Williams, J.R. and H.D. Berndt. 1977. "Determining the Universal Soil Loss Equation's Length-Slope Factor for Watershed; Soil Erosion Prediction and Control," Proceedings from the National Conference on Soil Erosion May 24-26, 1976. Soil Conservation Society of America; Ankeny, Iowa. 218-225 pp.

APPENDIX SECTION

Appendix A-1
Gross Erosion Assessment in the
Blue Creek Watershed
Pike County, Illinois

by

Ming T. Lee (1981)
Illinois State Water Survey

Gross erosion assessment is a part of the erosion-sedimentation study in the Blue Creek Watershed. The field data inventory was performed by Wayne Kinney, Steve Chick, and Edward Johnston of the Soil Conservation Service. The objectives of the assessment are to: 1) inventory the present soil, land use, and conservation practice conditions in the field; 2) compute the present soil loss rates in the watershed based on the present conditions; and 3) compute soil loss rates based on a few selected management practices to simulate the change of soil loss rates.

In order to relate the gross erosion data to sedimentation data, a sub-watershed upstream of suspended sediment gaging station C, which is located at the Highway 107 bridge, was selected for detailed gross erosion study. There are 73 soil mapping units in the sub-watershed. The total drainage area is 3,272 acres. The Universal Soil Loss Equation was used to compute the soil loss rates.

Under the present conditions, the total amount of annual gross erosion is 41,096 tons. This is equivalent to an average annual soil loss rate of 12.6 tons/acre/year. The average soil loss rates in the soil mapping units show high standard deviations which mostly are due to different land use categories.

The soil loss rates were also reported based on nine land use categories. Cropland is the dominant land use which covers about 58 percent of the watershed. The soil loss rate of the cropland is 18.1 tons which is the highest among all the land use categories. The second dominant land use is pasture which covers about 20 percent. The average soil loss rate from pasture is 4.4 tons/acre/year which is below the soil loss tolerance rate. The farmstead, residential, and hayland areas have relative small acreages. Their soil loss rates range from 0.2 to 5.5 tons/acre/year. The wildlife and woodland categories cover 7 percent (238 acres) and 6 percent (186 acres) which have soil loss rates of 2.9 and 4.9 tons/acre/year, respectively. The "other" land use consist of ideal, natural areas and small tract areas which were not defined in the inventory. This covers about 6 percent (188 acres) which has a soil loss rate of 11.9 tons/acre/year.

In order to simulate changes of soil loss rates due to the management practices, nine scenarios were selected. They are: 1) spring plow; 2) contour plowing; 3) conservation tillage with 1,500 pounds of residues;

4) conservation tillage with 3,500 pounds of residues; 5) conservation tillage with 6,000 pounds of residues; 6) terracing with 90 foot spacings; 7) terracing with 120 foot spacings; 8) terracing with 150 foot spacings; and 9) converting to pasture for 15 percent greater land slope.

If contour plowing is applied to the cropland, the total amount of gross erosion could be reduced to 68 percent of the present level and 57.2 percent of the watershed could meet the tolerance value (T value).

If spring plowing was applied to the watershed, the gross erosion could be reduced by 96 percent of the present level. This also indicated that 46.8 percent of the watershed will meet the T value.

If conservation tillages with 1,500, 3,500 and 6,000 pounds of residues were applied, the net effort will reduce the total amount of soil by 50, 34 and 26 percent of the present levels, respectively. The results also indicated that 60, 73 and 82 percent of the land will meet T value.

If terracing with 90, 120 and 150 foot spacings were applied to the watershed, the amount of soil loss could be reduced by 58, 62 and 65 percent of the present level and 63, 60 and 59 percent of the land would meet the T value.

If the conversion to pasture on 15 percent or greater land slope was implemented in the watershed, the gross erosion will be reduced by 84 percent of the present level and 48.4 percent of the land will meet the T value.

The amount of gross erosion and past reservoir sediment surveys were used to derive a sediment delivery ratio. The result indicated that about 48 percent of the sediment was delivered to the lake.

Appendix A-2
Land Cover/Water Quality Relationships Project
(Gates, 1981A)

The ADAPT system was selected for modelling in the Blue Creek watershed because of its unique, state of the art features. ADAPT, (areal design and planning tool) is a geo-based computer mapping and planning system. This computer modelling system represents a synthesis of two popular computer-based approaches to analysis and planning, 1) spatial/geographical data base; and 2) analytical mathematical modelling. The non-point source screening model, which uses the Universal Soil Loss Equation (USLE), was utilized to predict potential gross erosion.

USGS, 7 1/2 minute maps provided the topographic and political boundaries, soil series data was provided by the Soil Conservation Service (SCS). Land use/cover in five categories was furnished by IEPA from aerial photos. *USLE factors: C and P, were representative numbers provided by the SCS. The L factor, also obtained from SCS, was a representative figure for each soil series, the S factor (slope) was calculated by the ADAPT system.

A set of land management alternatives, representing use of one or a limited combination of management practices throughout the watershed, was developed through discussions with the Soil Conservation Service staff, representatives of Illinois Department of Agriculture and the consultant. Each alternative had the effect of changing the cover, cropping practice or slope length factors in the USLE. Calculation of total soil loss under these various circumstances gives a general idea of the relative effectiveness in this watershed of the different practices. Table 9 shows the acres, total erosion, erosion/acre, and % of area meeting tolerances (T) for each scenario. The soils in the Blue Creek watershed have a T value of 5 tons/acre/year.

Results

The study concluded that the ADAPT system provides a way for:

1. establishing project area priorities;
2. selecting Resource Management Systems for each priority area; and
3. estimating program costs and the need for cost-share funds.

In addition to these immediate benefits, the ADAPT system data base can be expanded and maintained, so that:

1. New management strategies at the watershed or local scale can be tested and compared.
2. It can be used, at the State level, to evaluate State strategies.
3. It may be applied to other resource management problems at local and State levels.

* Detailed information concerning the Universal Soil Loss Equation and the factors used in this project is in the Appendix Section.

TABLE 9

Summary of ten selected management alternatives in the Blue Creek Watershed.

SCENARIO #	ALTERNATIVE	GROSS EROSION (TONS/YR)	AVERAGE EROSION RATE (TONS/AC/YR)	PAT OF ACRES MEETING "T"
1	Conventional Tillage Residue Left Fall Up & Down Plowing	187,000	26.7	22.8
2	Conventional Tillage Contour Plowing Fall Plow	129,000	18.5	29.2
3	Spring Plowing Conventional Tillage	172,000	24.5	23.3
4	Conservation Tillage 1,500 lb. Residue	76,000	10.9	37.4
5	Conservation Tillage 3,500 lb. Residue	47,000	6.8	57.7
6	Conservation Tillage 6,000 lb. Residue	35,000	5.0	70.0
7	Terracing 90 Feet	103,000	14.8	36.3
8	Terracing 120 Feet	117,000	16.7	32.8
9	Terracing 150 Feet	129,000	18.4	30.6
10	Conservation to Pasture On Greater Than 15% Slope Land	152,000	21.6	25.8

Appendix A-3

Assessing Impacts of Cropland Management Practices on Potential Annual Erosion and Economic Factors For Individual Fields in the Blue Creek Watershed (Gates, 1981B)

The Land Cover/Water Quality Relationships Project demonstrated the application of ADAPT for priorization of areas for erosion control and for evaluation of the types of management practices to be employed at the basin and/or county-by-county level analysis. The initial evaluations were based soley on estimates of changes in total erosion and erosion rate and did not consider economic factors. These initial outputs were not intended to provide information at the detail required to evaluate specific field-level implementation strategies. The efforts of this second project were directed at developing these Field-by-Field level analyses, including economic considerations using the Blue Creek Watershed as the Project Study area.

A watershed base map was provided by IEPA on which discrete boundaries for the following land cover/use conditions were described: cropped fields, pasture/hayland (80% & 90% ground cover), managed woodland, unmanaged woodland, wildlife areas, farmsteads and feedlots. For each field in a row-crop rotation, the cropland management practices applicable to existing, attainable and ultimate management, conditions were defined by the Pike County District Conservationist.

Table 10 shows the acres, erosion and percent of total existing by land use/crop category for the three specified conditions.

Table 11 shows the acres and costs by land use/crop for the three specified conditions.

The project outputs show the impacts of the row-crop, field management practices on estimated erosion, and the economic analysis of the various row-crop field management practices. Outputs are in the form of multi-colored, shaped maps and computer generated tables. Tabular summaries were developed to show erosion and cost information by individual fields and by land use/cover type.

Table 10. Acres, average erosion, percent of the total erosion by land use/crop for the three specified management levels. (Gates, 1981B)

Land Use/ Crop Type	EXISTING CONDITION No. of Acres	Erosion (Tons/Acre)	Percent of Total Erosion	ATTAINABLE CONDITIONS No. of Acres	Erosion (Tons/Acre)	Percent of Total Erosion	ULTIMATE CONDITIONS No. of Acres	Erosion (Tons/Acre)	Percent of Total Erosion
C-S	760.2	26.0	31.47	447.6	9.3	13.68	342.7	5.1	8.41
C-C-S	315.5	22.0	11.05	315.5	8.6	8.28	258.9	7.5	9.38
Continuous Corn	931.7	15.6	23.14	1163.8	9.6	34.34	1117.1	6.8	36.77
C-S-G	129.5	14.9	3.07	217.4	6.9	4.63	238.9	4.4	5.02
C-S-G-M	466.1	8.6	6.40	410.0	4.5	5.70	456.3	2.9	6.28
C-S-G-M-M-M	601.3	7.3	6.96	616.8	4.7	8.83	688.1	2.8	9.26
C-S-G-M-M-M-M	756.3	5.8	6.98	759.7	3.9	9.05	792.2	2.8	10.71
Past/Hay 80% Cover	731.3	1.9	2.24	497.5	2.1	3.14	83.0	1.4	0.55
Past/Hay 95% Cover	788.0	0.3	0.37	1061.7	0.3	1.02	1546.5	0.4	2.73
Woodland-Managed	543.6	0.6	0.49	647.8	0.6	1.15	811.3	0.6	2.30
Woodland-Unmanaged	266.4	8.9	3.77	164.9	8.7	4.4	1.4	3.5	0.02
Wildlife	311.7	0.4	0.14	283.9	0.4	0.33	283.9	0.4	0.52
Farmstead	109.1	1.1	0.14	109.1	1.1	0.36	109.1	1.1	0.57
Feedlot	65.5	35.5	3.70	50.7	32.7	5.08	46.8	33.1	7.41
Water	236.4	0	0	236.4	0	0	236.4	0	0
TOTAL	7012.8	9.0	100	7012.8	4.7	100	7012.8	3.2	

C: Corn; S: Soybean; G: Grain; M: Meadow

Table 11. Acres, $/Acre to attain specified condition and percent of total cost to attain specified condition by land use crop for the the three specified management levels. (Gates, 1981B)

Land Use/ Crop Type	EXISTING CONDITION No. of Acres	$/Acre to Attain Condition	Percent of Total Cost to Attain Condition	ATTAINABLE CONDITIONS No. of Acres	$/Acre to Attain Condition	Percent of Total Cost to Attain Condition	ULTIMATE CONDITIONS No. of Acres	$/Acre to Attain Condition	Percent of Total Cost to Attain Condition
C-S	760.2	8.40	3.20	447.6	7.89	0.87	342.7	9.27	0.65
C-C-S	315.5	8.00	1.26	315.5	14.95	1.08	258.9	40.82	2.17
Continuous Corn	931.7	12.00	5.58	1163.8	12.53	3.35	1117.1	26.15	5.99
C-S-G	129.5	24.20	1.57	217.4	26.63	1.33	238.9	54.85	2.68
C-S-G-M	466.1	6.80	1.59	410.0	6.53	0.62	456.3	13.73	1.28
C-S-G-M-M-M	601.3	6.60	1.98	616.8	7.34	1.04	688.1	21.63	3.05
C-S-G-M-M-M-M	756.3	17.02	6.46	759.7	24.42	4.26	792.2	41.54	6.75
Past/Hay 80% Cover	731.3	0.76	0.28	497.5	80.00	9.15	83.0	80.00	1.36
Past/Hay 95% Cover	788.0	13.67	5.40	1061.7	36.96	9.02	1546.5	55.39	17.55
Woodland-Managed	543.6	128.81	35.10	647.8	137.38	20.46	811.3	130.78	21.74
Woodland-Unmanaged	266.4	0	0	164.9	103.72	3.93	1.4	0	0
Wildlife	311.7	100.65	15.73	283.9	134.54	8.78	283.9	134.54	7.83
Farmstead	109.1	0	0	109.1	84.81	2.13	109.1	84.81	1.90
Feedlot	65.5	665.49	21.86	50.7	2916.00	33.98	46.8	2817.83	27.04
Water	236.4	0	0	236.4	0	0	236.4	0	0
TOTAL	7012.8			7012.8			7012.8		

Appendix B

Information Required for Each Unit as Part of The SCS Land Resource Inventory Method

1. Sample number
2. Field number
3. Area (acreage)
4. Slope (percent)
5. Slope length (feet)
6. Land use code
7. Land cover code
8. Crop rotation
9. Practice factor (P) value
10. Residues, left (L) or removed (R)
11. Pounds of residues on the surface
12. Tillage, conventional fall (F) or spring (S) plow
13. Conservation tillage codes
14. Woodland stand condition well (W), medium (M) or poor (P)
15. Woodland percent of forest litter
16. Undergrowth, M or U
17. Woodland, tree canopy in percent
18. Grassland canopy in percent
19. Grassland ground cover in percent
20. Conservation factor (c)
21. Annual soil loss rates (tons/acre/year)
22. Soil series name
23. Hydrologic soil group A, B, or C
24. Soil loss tolerance value (T)
25. Soil erodibility value (K)
26. Urban density, low (L), medium (M), or high (M)
27. Applied conservation practice code
28. Needed conservation practice code

Appendix C

USLE Factors Utilized in the ADAPT County Level Study (Gates, 1981A)

	Cropland C-Factor	P-Factor
Pasture	.013	1.0
Woodland	0.08	1.0
Orchard	0.012	1.0

Slope Length -- Representative Value by Soil Association

R Factor 200

Average Annual Rain (37 inches)

Appendix D

List of Cropping Systems, Tillage Systems, And Conservation Practices Utilized in the ADAPT Field Level Study

Cropping Systems

- Corn -- Soybeans
- Corn -- Corn -- Soybeans
- Continuous Corn
- Corn -- Soybeans -- Grain
- Corn -- Soybeans -- Grain -- Meadow
- Corn -- Soybeans -- Grain -- Meadow -- Meadow -- Meadow
- Corn -- Soybeans -- Grain -- Meadow -- Meadow -- Meadow -- Meadow

Tillage Practices

- Moldboard Plow -- Spring
- Moldboard Plow -- Fall
- Chisel Plow -- 1 -- 2000 lbs. residue
- Chisel Plow -- 2 -- 3000 lbs. residue
- Chisel Plow -- 3 -- 4000 lbs. residue
- No-till -- 1 -- 2000 lbs. residue
- No-till -- 2 -- 3000 lbs. residue
- No-till -- 3 -- 4000 lbs. residue
- No-till -- 4 -- 6000 lbs. residue

Conservation Practices

- No Practice
- Contouring
- Terraces
- Stripcropping
- Pasture Seeding or Critical Area Seeding
- Livestock Exclusion
- Animal Waste System

Appendix E

Adapt Field Level 'Present Conditions'
"C" Factors For Row-Crop Fields (Gates, 19818)

Cropping System	TILLAGE SYSTEM								
	Mold. Plow Spring	Mold. Plow Fall	Chisel Plow 1-2000# RES	Chisel Plow 2-3000# RES	Chisel Plow 3-4000# RES	No-till 1-2000# RES	No-till 2-3000# RES	No-till 3-4000# RES	No-till 4-6000# RES
C-Sb	.43	.48	.32	.21	.16	.29	.16	.11	.06
C-C-Sb	.40	.44	.31	.21	.16	.29	.16	.11	.06
Continuous Corn	.37	.40	.31	.20	.12	.29	.16	.11	.06
C-Sb-Gr	.30	.33	.24	.17	.13	.15	.11	.09	.08
C-Sb-Gr-M	.16	.18	.15	.13	.11	.11	.08	.06	.05
C-Sb-Gr-M-M-M	.10	.12	.10	.08	.07	.07	.05	.05	.03
C-Sb-Gr-M-M-M-M-M	.08	.09	.08	.07	.06	.06	.04	.03	.02

Note: C-Sb calculated as average of continuous corn and continuous soybeans.

Appendix F

Adapt Field Level 'Present Conditions' (Gates, 1981B)

"P" Factors for Row-Crop Fields

% Slope	CONSERVATION PRACTICE						
	NO PRACTICE	CONTOURING	TERRACES	STRIP-CROPPING	PASTURE/CRITICAL AREA SEEDING	LIVESTOCK EXCLUSION	ANIMAL WASTE SYSTEM
≤1.0	1.0	0.60	0.60	0.45	1.0	1.0	1.0
1.1-2.0	1.0	0.60	0.60	0.45	1.0	1.0	1.0
2.1-7.0	1.0	0.50	0.50	0.40	1.0	1.0	1.0
2.1-12.0	1.0	0.60	0.60	0.45	1.0	1.0	1.0
12.1-18.0	1.0	0.80	0.80	0.60	1.0	1.0	1.0
18.1-24.0	1.0	0.80	0.0	0.70	1.0	1.0	1.0
>24.0	1.0	1.0	1.0	0.80	1.0	1.0	1.0

Appendix G

Adapt Field Level 'Present Conditions' (Gates 1981B)

"C" AND "P" FACTORS FOR NON ROW-CROP FIELDS; SLOPE LENGTH DATA

"C" Factors

LAND USE TYPE	"C"
Pasture/hayland -- 80% Ground Cover	0.013
Pasture/hayland -- 95% Ground Cover	0.003
Woodland -- Managed	0.003
Woodland -- Unmanaged	0.042
Wildlife	0.003
Farmstead	0.011
Feedlot	0.450

"P" Factors

"P" factor for non row-crop fields is 1.0 under all slope conditions

SLOPE LENGTH

Slope length is a function of soil type except in cases where row-crop fields use terracing. In those cases, the following slope lengths apply:

SLOPE	TERRACE LENGTH
<%5	150 feet
5-10%	120 feet
>10%	90 feet

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